

Claims

- [c1] *Sub A* 1. A tool for forming a hem on a sheet metal assembly comprising an inner panel having an outwardly extending flange and an outer panel having a bendable flange that is initially oriented generally perpendicular to an outer peripheral portion of the outer panel, the tool comprising:
- a supporting surface on which the outer panel and inner panel are located;
- a roller having a cylindrical surface that is used to bend the flange inwardly and toward a surface of the outwardly extending flange of the inner panel facing away from the outer panel, the roller having a concave portion extending from a first circumferential line at the intersection of the concave portion and the cylindrical surface to a second circumferential line axially spaced from the first circumferential line, wherein the concave portion is formed by at least two surfaces that together define a cavity relative to a chord extending between the first and second circumferential lines.
- [c2] 2. The tool of claim 1 wherein the surfaces defining the cavity include two conical surfaces that lie in two different coaxial conical sections that are coaxial with the cylindrical surface.
- [c3] 3. The tool of claim 2 wherein the surfaces defining the cavity further include a third conical surface that lies in a third coaxial conical section that is different than the two other conical sections and coaxial with the cylindrical surface.
- [c4] 4. The tool of claim 3 wherein the surfaces defining the cavity further include a fourth conical surface that lies in a fourth coaxial conical section that is different than the three other conical sections and coaxial with the cylindrical surface.
- [c5] 5. The tool of claim 1 wherein the surfaces defining a cavity include a conical surface that lies in a coaxial conical section that is coaxial with the cylindrical surface and a curved surface that is contiguous with the conical surface and also coaxial with the cylindrical surface.
- [c6] 6. The tool of claim 5 wherein the curved surface is between the conical surface and the cylindrical surface and is also contiguous with the cylindrical surface.

- [c7] 7. The tool of claim 1 wherein the cylindrical surface is oriented to contact an inner portion of the flange as it is pressed against the outwardly extending flange of the inner panel while at least one of the surfaces forming the concave portion engages an intermediate portion of the flange that extends from a bight portion of the flange to the inner portion.
- [c8] 8. The tool of claim 7 wherein a bend in the flange between the inner portion of the flange and the intermediate portion of the flange is engaged by the roller proximate the first circumferential line.
- [c9] 9. The tool of claim 7 wherein the concave portion applies force in a direction normal to the intermediate portion of the flange.
- [c10] 10. The tool of claim 2 wherein the cylindrical surface applies force to the inner portion of the flange to flatten the flange against the outwardly extending flange of the inner panel.
- [c11] 11. The tool of claim 10 wherein the cylindrical surface is used in a pre-hemming step to initially bend the flange from its initial generally perpendicular orientation to extend at an angle of generally 45 ° and partially over the outwardly extending flange of the inner panel.
- [c12] 12. The tool of claim 1 wherein the concave portion has an outer circumference that is greater than the circumference of the cylindrical surface.
- [c13] 13. The tool of claim 1 wherein the concave portion has an outer circumference that is less than the circumference of the cylindrical surface.
- [c14] 14. A forming tool for forming a compressed radius hem for securing two panels together comprising:
a first forming surface that is parallel to the perimeter portion of the inner panel;
a second forming surface contiguous with the first forming surface that is oriented at a first oblique angle relative to the first forming surface; and
a third forming surface contiguous with the second forming surface that is oriented at a second oblique angle relative to the first forming surface that is

less oblique to the first forming surface than the first oblique angle.

[c15] 15. The forming tool of claim 14 wherein the forming tool is a roller.

[c16] 16. The forming tool of claim 14 wherein the forming tool is a press die.

[c17] 17. A method of hemming an outer metal panel having a perimeter flange extending generally perpendicularly relative to the body of the outer panel and an inner metal panel together, the method comprising:

placing the inner panel and outer panel together;

forming the perimeter flange in a pre-hem pass with a roller to bend the perimeter flange to an acute angle relative to the body of the outer panel; and

forming the perimeter flange of the outer panel in a final pass over and into engagement a perimeter portion of the inner panel with the roller having a first forming surface that is parallel to the perimeter portion of the inner panel, and a second forming surface contiguous with the first forming surface and that is oriented at a first oblique angle relative to the first forming surface.

= wires
fig 6

[c18] 18. The method of claim 17 wherein a third forming surface is provided that is spaced from the first forming surface and is contiguous with the second forming surface and is oriented at a second oblique angle relative to the first forming surface that is less oblique than the first oblique angle.